

WHAT IS CLAIMED IS:

1. A method of measuring non-linearity in the input/output of an object which receives input signals and produces output signals in response to the input signals, comprising the steps of:
- 5 feeding signals of a reference pattern to said object to measure a first predetermined harmonic component from the output signals thereof;
- selecting signals of a pattern from
10 signals of plural kinds of predetermined patterns;
- feeding signals of said selected pattern to said object cyclically to measure a second predetermined harmonic component from the output signals thereof; and
- 15 calculating a non-linear transition shift NLTS in said object from said first predetermined harmonic component and from said second predetermined harmonic component.
2. A method of measuring non-linearity in the magnetic recording/reproduction of a medium comprising the steps of:
- 20 measuring a first predetermined harmonic component from the reproduced signals of the reference signals magnetically recorded in a medium;
- 25 measuring a second predetermined harmonic component from the reproduced signals for each of the plural kinds of to-be-measured signals magnetically recorded in said medium; and
- calculating a non-linear transition shift
30 NLTS in the magnetic recording/reproduction from said first predetermined harmonic component and from said second predetermined harmonic component corresponding to each of the to-be-measured signals.
3. A measuring method according to claim 2 above,
35 wherein said predetermined harmonic component is a fifth harmonic component.
4. A measuring method according to claim 3 above,

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wherein said reference signals are the ones obtained by cyclically and serially shifting, from an optional bit, the data of a bit-string pattern for magnetically recording the data into said medium by once effecting the magnetization and demagnetization for the same period of time, respectively; and wherein

said plural kinds of predetermined bit-string patterns include:

a first pattern of bit strings each including a tribit in which the magnetic inversion occurs continuously for three bits in each period of said magnetization and demagnetization;

a second pattern of bit strings each including 2T in which the magnetic inversion occurs after an interval of two bits in each period of said magnetization and demagnetization; and

a third pattern of bit strings including a bit constitution HTS in which the magnetic inversion occurs in a manner that the magnetization occurs in a direction opposite to the direction of magnetization of the record in the medium.

5. A measuring method according to claim 4 above, wherein, when a bit that undergoes the magnetic inversion is denoted by 1, said reference signals are those signals repeating a pattern of a 30-bit string of 100000000000000 100000000000000 in which the magnetic inversion occurs at the 0th bit and at the 15th bit, and said first pattern is a 30-bit string of 111000110100100 111000110000000 in which the magnetic inversion occurs at the 0th, 1st, 2nd, 6th, 7th, 9th, 12th, 15th, 17th and 21st bits and at the 22nd bit.

6. A measuring method according to claim 4 above, wherein, when a bit that undergoes the magnetic inversion is denoted by 1, said reference signals are those signals repeating a pattern of a 30-bit string of 100000000000000 100000000000000 in which the magnetic inversion occurs at the 0th bit and at the 15th bit, and said second pattern

is a 30-bit string of 101000001000000 101000001000000 in which the magnetic inversion occurs at the 0th, 2nd, 8th, 15th and 17th bits and at the 23rd bit.

5 7. A measuring method according to claim 4 above, wherein, when a bit that undergoes the magnetic inversion is denoted by 1, said reference signals are those signals repeating a pattern of a 30-bit string of 100000000000000 1000000000000000 in which the magnetic inversion occurs at the 0th bit and at the 15th bit, and said third pattern
10 is a 30-bit string of 101010101000101 010101000000000 in which the magnetic inversion occurs at the 0th, 2nd, 4th, 6th, 8th, 12th, 14th, 16th and 18th bits and at the 20th bit.

15 8. A measuring method according to any one of claims 2 to 7, wherein said NLTS is measured within an error range of 5%.

20 9. An LSI for magnetic recording/reproduction which generates reference signals that are to be magnetically recorded into a medium, measures a first predetermined harmonic component from the reproduced signals thereof, generates to-be-measured signals corresponding to said reference signals that are to be magnetically recorded into said medium, and measures a second predetermined harmonic component from the
25 reproduced signals thereof, wherein there is incorporated a circuit for generating a bit-string pattern in common with said plural kinds of bit-string patterns and plural kinds of predetermined bit-string patterns forming said to-be-measured signals.

30 10. An LSI for magnetic recording/reproduction which generates reference signals that are to be magnetically recorded into a medium, measures a first predetermined harmonic component from the reproduced signals thereof, generates to-be-measured signals
35 corresponding to said reference signals that are to be magnetically recorded into said medium, and measures a second predetermined harmonic component from the

reproduced signals thereof, wherein there is incorporated a circuit for measuring a predetermined harmonic component from said reference signals and from the reproduced signals of plural to-be-measured signals corresponding to one of said reference signals.

11. An LSI for magnetic recording/reproduction which generates reference signals that are to be magnetically recorded into a medium, measures a first predetermined harmonic component from the reproduced signals thereof, generates to-be-measured signals corresponding to said reference signals that are to be magnetically recorded into said medium, and measures a second predetermined harmonic component from the reproduced signals thereof, wherein there are incorporated a circuit for generating a bit-string pattern forming said reference signals and a predetermined bit-string pattern forming said to-be-measured signals, and a circuit for measuring a predetermined harmonic component from said reference signals recorded in said medium and from the reproduced signals said to-be-measured signals.

12. An LSI according to claim 9 or 11 above, wherein, when a bit that undergoes the magnetic inversion is denoted by 1, said reference signals are those signals repeating a pattern of a 30-bit string of 100000000000000 100000000000000 in which the magnetic inversion occurs at the 0th bit and at the 15th bit, and said first pattern is a 30-bit string of 111000110100100 111000110000000 in which the magnetic inversion occurs at the 0th, 1st, 2nd, 6th, 7th, 9th, 12th, 15th, 17th and 21st bits and at the 22nd bit.

13. An LSI according to claim 9 or 11 above, wherein, when a bit that undergoes the magnetic inversion is denoted by 1, said reference signals are those signals repeating a pattern of a 30-bit string of 100000000000000 100000000000000 in which the magnetic inversion occurs at the 0th bit and at the 15th bit, and said second pattern

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is a 30-bit string of 101000001000000 101000001000000 in which the magnetic inversion occurs at the 0th, 2nd, 8th, 15th and 17th bits and at the 23rd bit.

14. An ISL according to claim 9 or 11 above,
5 wherein, when a bit that undergoes the magnetic inversion is denoted by 1, said reference signals are those signals repeating a pattern of a 30-bit string of 100000000000000 100000000000000 in which the magnetic inversion occurs at the 0th bit and at the 15th bit, and said third pattern
10 is a 30-bit string of 101010101000101 010101000000000 in which the magnetic inversion occurs at the 0th, 2nd, 4th, 6th, 8th, 12th, 14th, 16th and 18th bits and at the 20th bit.

15. An LSI for magnetic recording/reproduction
15 according to claim 9 above, wherein said LSI for magnetic recording/reproduction includes a circuit for measuring the fifth harmonic component from the reproduced signals of the data read from said medium in which the data have been stored using said reference signals or said to-be-measured signals.
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16. An LSI for magnetic recording/reproduction
according to claim 15 above, wherein said LSI for magnetic recording/reproduction includes a circuit for calculating a ratio V_{ab} ($= V_{5pat}/V_{5ref}$) of a second fifth
25 harmonic component V_{5pat} which is a reproduced signal of the data read from said medium in which the data have been recorded using said to-be-measured signals to a first fifth harmonic component V_{5ref} which is a reproduced signal of the data from said medium in which
30 the data have been recorded by using said reference signals.

17. An LSI for magnetic recording/reproduction
according to claim 16 above, wherein said LSI for magnetic recording/reproduction includes a circuit for
35 calculating a non-linear transition shift NLTS in the magnetic recording/reproduction based upon said ratio V_{ab} ($= V_{5pat}/V_{5ref}$) calculated from said first fifth harmonic

component V5ref and said second fifth harmonic component V5pat.

18. An LSI for magnetic recording/reproduction according to any one of claims 10, 15, 16 or 17 (above),
5 wherein said circuit for measuring the fifth harmonic component includes a high-speed Fourier transform circuit.

505 a 17 19. An LSI for magnetic recording/reproduction according to any one of claims 9 to 18 above, wherein
10 said LSI for magnetic recording/reproduction includes a circuit for adjusting a write compensation circuit based upon said fifth harmonic component.

505 a 17 20. A device for magnetic recording/reproduction mounting an LSI for magnetic recording/reproduction of
15 any one of claims 9 to 19.

21. A device for magnetic recording/reproduction for measuring the non-linearity in the magnetic recording/reproduction of a medium by generating reference signals that are to be magnetically recorded
20 into a medium, measuring a first predetermined harmonic component from the reproduced signals thereof, generating to-be-measured signals corresponding to said reference signals that are to be magnetically recorded into said medium, measuring a second predetermined harmonic
25 component from the reproduced signals thereof, and calculating a non-linear transition shift NLTS in said magnetic recording/reproduction from said first predetermined harmonic component and said second predetermined harmonic component, wherein there are
30 provided means for selecting data of a bit-string pattern from the data of a bit-string pattern in common with said plural kinds of bit-string patterns and of plural kinds of predetermined bit-string patterns forming said to-be-measured signals, and means for generating said reference
35 signals or said to-be-measured signals by cyclically and serially shifting the data of said selected bit-string pattern starting from any bit.

22. A device for magnetic recording/reproduction
for measuring the non-linearity in the magnetic
recording/reproduction of a medium by generating
reference signals that are to be magnetically recorded
5 into a medium, measuring a first predetermined harmonic
component from the reproduced signals thereof, generating
to-be-measured signals corresponding to said reference
signals that are to be magnetically recorded into said
medium, measuring a second predetermined harmonic
10 component from the reproduced signals thereof, and
calculating a non-linear transition shift NLTS in said
magnetic recording/reproduction from said first
predetermined harmonic component and said second
predetermined harmonic component, wherein there is
15 provided means for measuring a predetermined harmonic
component from said reference signals and from a
reproduced signal of a to-be-measured signal
corresponding to one of said reference signals.

23. A device for magnetic recording/reproduction
20 for measuring the non-linearity in the magnetic
recording/reproduction of a medium by generating
reference signals that are to be magnetically recorded
into a medium, measuring a first predetermined harmonic
component from the reproduced signals thereof, generating
25 to-be-measured signals corresponding to said reference
signals that are to be magnetically recorded into said
medium, measuring a second predetermined harmonic
component from the reproduced signals thereof, and
calculating a non-linear transition shift NLTS in said
30 magnetic recording/reproduction from said first
predetermined harmonic component and said second
predetermined harmonic component, wherein there are
provided means for generating said reference signals or
said to-be-measured signals by selecting data of a bit-
35 string pattern from the data of the bit-string pattern
forming said reference signals and of a predetermined
bit-string pattern forming said to-be-measured signals,

and cyclically and serially shifting the data of said selected bit-string pattern starting from any bit, and means for measuring a predetermined harmonic component from the reproduced signals of the data read from said medium in which the data have been recorded by using said reference signals and said to-be-measured signals recorded in said medium.

24. A device according to claim 21 or 23 above, wherein, when a bit that undergoes the magnetic inversion is denoted by 1, said reference signals are those signals repeating a pattern of a 30-bit string of 100000000000000 1000000000000000 in which the magnetic inversion occurs at the 0th bit and at the 15th bit, and said first pattern is a 30-bit string of 111000110100100 111000110000000 in which the magnetic inversion occurs at the 0th, 1st, 2nd, 6th, 7th, 9th, 12th, 15th, 17th and 21st bits and at the 22nd bit.

25. A device according to claim 21 or 23 above, wherein, when a bit that undergoes the magnetic inversion is denoted by 1, said reference signals are those signals repeating a pattern of a 30-bit string of 100000000000000 1000000000000000 in which the magnetic inversion occurs at the 0th bit and at the 15th bit, and said second pattern is a 30-bit string of 101000001000000 101000001000000 in which the magnetic inversion occurs at the 0th, 2nd, 8th, 15th and 17th bits and at the 23rd bit.

26. A device according to claim 21 or 23 above, wherein, when a bit that undergoes the magnetic inversion is denoted by 1, said reference signals are those signals repeating a pattern of a 30-bit string of 100000000000000 1000000000000000 in which the magnetic inversion occurs at the 0th bit and at the 15th bit, and said third pattern is a 30-bit string of 101010101000101 010101000000000 in which the magnetic inversion occurs at the 0th, 2nd, 4th, 6th, 8th, 12th, 14th, 16th and 18th bits and at the 20th bit.

27. A device for magnetic recording/reproduction

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according to claim 21 above, wherein said LSI for magnetic recording/reproduction includes a circuit for measuring the fifth harmonic component from the reproduced signals of the data read from said medium in which the data have been stored using said reference signals or said to-be-measured signals.

28. A device for magnetic recording/reproduction according to claim 27 above, wherein said LSI for magnetic recording/reproduction includes a circuit for calculating a ratio V_{ab} ($= V_{5pat}/V_{5ref}$) of a second fifth harmonic component V_{5pat} which is a reproduced signal of the data read from said medium in which the data have been recorded using said to-be-measured signals to a first fifth harmonic component V_{5ref} which is a reproduced signal of the data from said medium in which the data have been recorded by using said reference signals.

29. A device for magnetic recording/reproduction according to claim 27 above, wherein said LSI for magnetic recording/reproduction includes a circuit for calculating a non-linear transition shift NLTS in the magnetic recording/reproduction based upon said ratio V_{ab} ($= V_{5pat}/V_{5ref}$) calculated from said first fifth harmonic component V_{5ref} and said second fifth harmonic component V_{5pat} .

30. A device for magnetic recording/reproduction according to any one of claims 22, 27, 28 and 29 above, wherein said means for measuring the fifth harmonic component includes a Fast Fourier Transform unit.

30 ~~31.~~ A device for magnetic recording/reproduction according to any one of claims 21 to 30 above, wherein said device for magnetic recording/reproduction includes means for adjusting a write compensation circuit based upon said fifth harmonic component.

35 ~~32.~~ A device for magnetic recording/reproduction according to any one of claims 21 to 31 above, wherein said device for magnetic recording/reproduction includes

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a magnetic reluctance-type head for detecting said reproduced signals.

5 ^{505 a37} 33. A device for magnetic recording/reproduction according to any one of claims 20 to 32 above, wherein said NLTS is measured within an error range of 5%.

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